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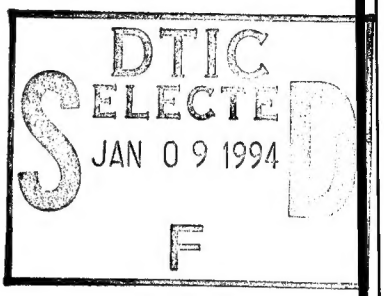
WASTEWATER TREATMENT PLANT ENVIRONMENTAL STUDY HOWARD AIR FORCE BASE, PANAMA Phase III



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Final Contractor Report for Period October 1993 - July 1994

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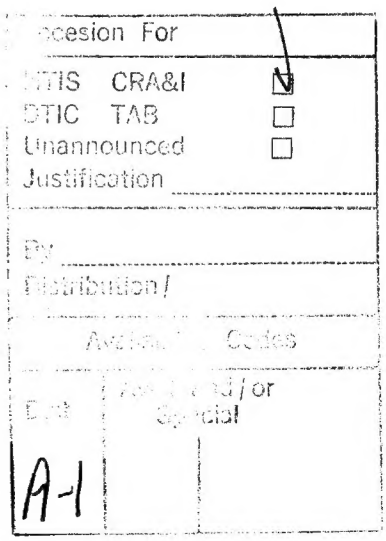

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PREFACE

This report is a record of actions taken at Howard Air Force Base, Panama, under the Wastewater Treatment Plant Environmental Study Program for the purpose of improving the performance of the wastewater treatment plant serving that installation.

During Phase III of the project, an on-site visit was made at Howard AFB by a senior operations specialist from Engineering-Science, Inc. During the on-site visit, plant operations were reviewed to ascertain the effectiveness of previous phases of the program, to determine the current status of previous recommendations and to evaluate and determine overall effectiveness of the program.

EXECUTIVE SUMMARY

The Wastewater Treatment Plant Environmental Study Program is a major program designed to correct operational and maintenance shortcomings at U.S. Air Force wastewater treatment plants. This is a three-phase program, as outlined below:

- Phase I--On-site diagnostic evaluation of a plant to identify shortcomings and determine what assistance is needed to correct them.
- Phase II--Preparation of a plant-specific Operation and Maintenance Manual and on-site implementation and support for improving O&M, and/or sampling and laboratory analyses.
- Phase III--On-site follow-up evaluation to assess the effectiveness of assistance provided during Phase I and Phase II.

The Phase I visit was conducted October 25-29, 1993 by Mike Hewitt and Carlos Ortiz of Engineering-Science. A total of 34 recommendations were made as a result of the Phase I visit. These recommendations were made to optimize the operation of the WWTP and to ensure compliance with Overseas Baseline Criteria in a cost-effective manner. A summary of all Phase I recommendations is provided in Section 2 of this report.

The Phase II on-site visits were conducted over a four months period between March 1994 and June 1994. The dates and ES team members conducting these site visits are as follows:

March 17-18, 1994	Mike Hewitt
April 20-21, 1994	Mike Hewitt
May 18-19, 1994	Mike Hewitt
June 29-30, 1994	Mike Hewitt

During each of the on-site visits, the status of all previous recommendations was updated, assistance was provided to implement recommendations; and activities related to preparations and validation of the O&M Manual contents were performed. The draft O&M Manual was delivered to the Base on March 30, 1994. Section 3 of this report provides documentation on the status of the project during Phase II.

The Phase III on-site visit was conducted on August 16-19, 1994 by Mike Hewitt of Engineering-Science, Inc. During this visit an overall reassessment of the plant O&M was made, the progress toward implementation of recommendations was evaluated,

additional assistance, particularly with regard to plant process control was provided, and the benefits accrued as the result of the WWTP Environmental Study Program were assessed. Section 4 of this report documents the activities of the Phase III visit.

At the time of the Phase III visit, the WWTP operation had greatly improved. Plant personnel had fully implemented a process control strategy for the plant and the plant performance had improved dramatically since the inception of the project. The process control and performance improvement are directly attributable to the increased interest and attention being paid to the plant by operational personnel and their implementation of the study recommendations.

The format of the Phase III report generally follows that provided in "A Guide to the Department of Defense Operation, Maintenance and Training Assistance Program (OMTAP) for Wastewater Treatment Plant Personnel," June 1987.

SECTION 1
INTRODUCTION

1.1 DESCRIPTION OF OMTAP

The Wastewater Treatment Plant Environmental Study Program is a Department of Defense program designed to improve the performance of wastewater treatment plants located on military installations. The program is divided into three phases, each requiring visits to the treatment facility by one or more evaluators.

The first phase (Diagnostic Phase) involves a comprehensive diagnostic evaluation of the treatment plant or laboratory to identify deficiencies in operation or design. During this site visit, the evaluation team members conduct a comprehensive process or laboratory evaluation and collect information needed to produce a draft of an operation and maintenance manual. Reviews of all pertinent procedures are performed on site. Evaluation of plant and/or laboratory records are also conducted.

The second phase (Assistance Phase) involves up to four site visits to provide implementation and support for operators and/or laboratory personnel on procedures recommended to overcome those problems identified during the diagnostic phase. The visits occur several months after the program is in process at an Air Force installation. The team also validates the content of the draft O&M manual and examines operational and procedural problems in more depth.

The third phase (Verification Phase) which occurs 8 to 12 months after the initial visit is a follow-up verification of plant or lab performance to assess those improvements that have been made since the program's inception and the benefits accrued. If needed, additional assistance that might benefit the operators or the lab personnel is provided.

1.2 PURPOSE AND ACTIVITIES OF PHASE III VISIT

In addition to re-evaluating plant operations and verifying the status of recommendations made during Phase I and II of the project, the ES project manager held informal discussions with the acting plant superintendent and laboratory analyst on operational problems at the plant in an attempt to continue operator input into the program.

During the Phase III visit, the ES project manager participated in a number of meetings with base personnel. These meetings are summarized below:

On August 16, 1994, at 0800 hours, Mike Hewitt met with Mr. Alzamora and Mr. Parris at the WWTP to discuss issue related to the process operation and control strategy.

Strategies for controlling the filamentous organism growth that has reoccurred were discussed. Alternative methods for controlling the return activated sludge pumping rates were reviewed. Also on August 16, a short teleconference was conducted with Mr. Gary Nault of HQ ACC to determine the status of funding for the plant upgrade. Also on August 16, at 1400 hours Mike Hewitt met with Captain Dan Agramonte, the Chief of SABRE to discuss the WWTP Environmental Study, the on-going WWTP design upgrade and overall needs of the plant.

On August 17, 1994, at 0700, Mike Hewitt met briefly with Major Bridges, the Civil Engineering Operations Chief to set up the project outbriefing. The remainder of August 17th was spent reviewing progress made during the project and the benefits accrued as a result of the project. Also twelve months of operating data was collected to compare with data from the beginning of the project and to assess compliance.

On August 18, 1994, at 0730 hours, an outbriefing meeting was conducted at the 24th CES Building. A list of persons attending the meeting and a summary of the out-briefing was included with Letter Report No. 7. Following the outbriefing, meetings were held at the WWTP with Mr. Alzamora and Mr. Parris to discuss upcoming changes planned to fine-tune the WWTP activated sludge process. Discussions were held regarding changing the target sludge retention time from five to seven days. Also, additional assistance was provided in the use of the process spreadsheet and development of process trend charts.

SECTION 2
DIAGNOSTIC PHASE SUMMARY

2.1 SUMMARY OF SITE VISIT

The Phase I visit was conducted to perform an on-site diagnostic evaluation of the Howard Air Force Base wastewater treatment plant (WWTP). The purpose of the visit was to provide site specific assistance to the WWTP staff and correct deficiencies and less than optimum practices.

The Phase I on-site diagnostic evaluation of the WWTP was conducted during the period of October 25-29, 1993. Members of the Engineering-Science (ES) Team included:

- Mike Hewitt - ES Project Manager
- Carlos Ortiz - ES Project Engineer

During the period of the Phase I visit, the ES team members evaluated the operation and maintenance of the treatment facility. This was accomplished through on-site observations, meetings and interviews with operators and other base personnel, and document and data review.

2.2 ACCOMPLISHMENTS OF PHASE I VISIT

During the Phase I visit, the team made a number of significant accomplishments. The major accomplishments include:

- Diagnostic evaluation of each unit treatment process.
- Evaluation of sampling, laboratory procedures and analytical equipment.
- Evaluation of preventive maintenance and safety programs.
- Evaluation of plant recordkeeping systems.
- Evaluation of operator job skills, training and promotion opportunities.
- Evaluation of management structure for the WWTP.
- Evaluation of the effect of non-domestic discharges on the WWTP.
- Inspection and evaluation of all remote lift stations.

2.3 PHASE I OBSERVATIONS AND RECOMMENDATIONS

Recommendations of needed improvements, modifications and changes in operating practices were included in the Phase I Diagnostic Report dated January 1994. A summary of these recommendations are presented in Table 2.1.

TABLE 2.1
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
ESTIMATED IMPLEMENTATION COSTS

	Recommendation	Comments/Significance	Estimated Cost of Implementation
1.	Implement a process control strategy for the activated sludge process based on maintaining a constant sludge retention time (SRT).	Raw data required for the calculation of SRT includes MLVSS, aeration basin volume, WAS VSS, effluent flow effluent TSS and WAS flow.	See items 2 and 3.
2.	Procure a new muffle furnace with adequate temperature monitoring and control so that volatile suspended solids can be run for process control.	Required temperature for volatile solids or volatile suspended solids is 550°C ± 50°C.	$2,000
3.	Install flow meters on RAS and WAS lines to have reliable flow data for process control of activated sludge system.	RAS system - 8" mag meter. WAS system - 4" mag meter.	This is a design/upgrade item which will require engineering design services to determine accurate cost estimates.
4.	Establish a new effluent sampling location for total and volatile suspended solids prior to the chlorine contact chamber.	Possibly tap into the secondary clarifier effluent line just ahead of the chlorine contact chamber.	$100
5.	Level the secondary clarifier weirs to reduce short circuiting and solids carryover.	Will require support from civil engineering squadron personnel. Will require new hardware.	$200
6.	Obtain additional analytical data on the wastewater treatment plant influent, effluent and sludge.	• Metals and toxic organics semiannually on the influent, effluent and sludge. • COD, TKN and total phosphorous on the influent monthly for six consecutive months.	$1,200 for commercial lab services $420 for commercial lab services
7.	Upgrade the influent pump station/controls to provide variable speed drives and flow pacing off the influent flow meter.	Forward flow to the plant should not be intermittent as is presently the case.	This is a design/upgrade item which will require engineering design services to determine accurate cost estimates.
8.	A plant-wide daily operations log or daily plant checklists should be implemented to ensure that all operator duties are completed each day and a record is maintained of plant operations.	A daily log or operator checksheets will be developed for the O&M manual.	No cost.

TABLE 2.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
ESTIMATED IMPLEMENTATION COSTS

Recommendation	Comments/Significance	Estimated Cost of Implementation
9. A formal training requirement should be implemented for all employees in the Wastewater Treatment Plant Operator classification.	"Operation of Wastewater Treatment Plants" offered by California State University could be utilized as a course for operators at Howard AFB.	$100 per operator.
10. The WWTP should be staffed 24 hours per day. The third shift (2400 Hours - 0800) should be manned as soon as arrangements can be made to provide additional operators or to provide a security fence.	Process observations and adjustments should be made around the clock by plant personnel at activated sludge plants.	$15,000 for security fencing around plant. $23,000 annually for salary plus fringe benefits for a WWTP operator.
11. Improve the overall organization of plant filing system.	Make all information readily available and accessible.	Staff time - no cost.
12. Purchase reference/self-study material listed in Section 3 of this report for the WWTP.		$400
13. Provide additional technical training opportunities for the current and future NCOIC of the WWTP.	Technical knowledge is necessary for effective WWTP management.	$1,000 - $2,000 annually depending on course and location.
14. Improve ventilation in Lift Station 735 through installation of exhaust fan and/or louvered windows.	Hydrogen sulfide gas build up evident during evaluation.	$1,000 - $1,500
15. Implement contract to repair/renovate aeration header line as soon as possible.	TSgt. Mourning indicated on December 20, 1993 that this work was scheduled for early January.	N/A - Recommendation not initiated by ES Evaluation Team.
16. Maintain a dissolved oxygen (DO) residual of 2.0 mg/l throughout aeration basins.	To ensure adequate D.O. for microbial activity.	Normal operating costs.
17. Control of the aerobic digesters should be established based on percent reduction of volatile solids. Reduction in volatile solids should be greater than 40 % prior to drawing sludge to beds.	Percent reduction in volatile solids should be greater than 40 prior to draining sludge to drying beds.	No cost other than purchasing a muffle furnace.

TABLE 2.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
ESTIMATED IMPLEMENTATION COSTS

Recommendation	Comments/Significance	Estimated Cost of Implementation
18. Sludge should be drawn to the drying beds no greater than 8-12 inches in depth. If reducing depth does not improve dewatering, an evaluation of the drying bed media should be performed to determine if sand and gravel replacement is needed.	8-12 inches promotes rapid dewatering of sludge and facilitates removal of sludge from the beds.	None initially.
19. Repair influent flow recorder/totalizer.	Troubleshooting and diagnosis required by manufacturer's representative to obtain estimate of repair/replacement cost.	Cost unknown.
20. The WWTP should develop a written spare parts inventory.	To ensure that spare parts are available when needed and ordered when depleted.	None.
21. The base should help expedite the procurement of maintenance supplies such as grease.	To ensure that there is an adequate supply on hand at all times.	None.
22. Chlorinated samples used for BOD analysis must be dechlorinated and reseeded prior to setting up sample dilutions.	This is a requirement of the test procedure as specified in standard methods.	None.
23. Amend lab monitoring procedures per discussions in Section 6.2.2 - 6.2.5.	• BOD • TSS • pH • Fecal Coliform	None.
24. Amend lab record keeping in accordance with Section 6.2.2 - 6.2.5.	• Temperature Logs • Calibration Records • Bench Sheets	None.
25. Run D.O. profiles in the aeration basins monthly.	Refer to Section 6.2.5.	$150 for new D.O. probe/cable.

TABLE 2.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
ESTIMATED IMPLEMENTATION COSTS

Recommendation	Comments/Significance	Estimated Cost of Implementation
26. Initiate volatile solids analyses on the aeration basins and aerobic digesters each time total or total suspended solids are analyzed.	Aeration Basins - TSS Digesters - % Total Solids	None.
27. Implement improved record keeping and file organization for WWTP records.	• Manufacturer's Literature • Lab Bench Data Sheets • WWTP Log and Supplemental • Daily Log or Checklists	None.
28. Change the storage location of the SCBA to a point that would be accessible during a chlorine leak.	Possibly the inside wall of the influent pump station building.	Minimal cost.
29. Install an additional safety shower/eyewash in the same location as the SCBA.	Possibly the inside wall of the influent pump station building.	$500.00
30. Document weekly safety briefings.	Include topic(s) discussed and person attending.	None.
31. Provide life rings in the area of the grit chamber and influent wet well.	The nearest life ring to this area is currently on the aeration basins.	$50.00
32. The lead-lag status of the lift station pumps should be manually alternated	Monthly	None
33. Grit and screenings should be buried or disposed of in a santary landfill if available.	Surface disposal is a potential health hazard.	None
34. Provide a combustile gas/O_2 meter for plant personnel.	Safe entry in lift stations, chlorine rooms, etc.	$1500

SECTION 3
ASSISTANCE PHASE SUMMARY

3.1 SUMMARY OF SITE VISITS

The major purpose of the Phase II site visits was to provide assistance and support in the implementation of the recommendations made in Phase I of the WWTP Environmental Study Project. During Phase II, the Operations and Maintenance Manual for the WWTP was drafted. A second major purpose of Phase II is to verify and validate the contents of the O&M Manual at the plant site. Four, 2-day, on-site visits were conducted at the Howard AFB WWTP. The dates of these visits are as follows:

1 - March 17-18, 1994

2 - April 20-21, 1994

3 - May 18-19, 1994

4 - June 29-30, 1994

During each site visit, a careful review of the current status of each of the recommendations from Phase I was made. Assistance was provided in implementing the recommendation where possible, and the progress made was documented in Letter Reports 3, 4, 5 and 6.

3.2 STATUS OF PROJECT RECOMMENDATIONS IN PHASE II

The status of all project recommendations from Phase I and Phase II were summarized at the conclusion of the fourth Phase II visit in Letter Report No. 6. Those recommendations and their status at the conclusion of the assistance phase are included here in Table 3.1 and 3.2.

TABLE 3.1
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

	Recommendation	Comments/Significance	Current Status of Phase I Recommendations
1.	Implement a process control strategy for the activated sludge process based on maintaining a constant sludge retention time (SRT).	Raw data required for the calculation of SRT includes MLVSS, aeration basin volume, WAS VSS, effluent flow effluent TSS and WAS flow.	Efforts to implement a process control strategy using sludge retention time (SRT) as the primary process control parameter have been completed. The plant has been provided with a personal computer with spreadsheet program. A spreadsheet for entering and manipulating process data so that SRT and sludge wasting rates is being used on a daily basis.
2.	Procure a new muffle furnace with adequate temperature monitoring and control so that volatile suspended solids can be run for process control.	Required temperature for volatile solids or volatile suspended solids is 550°C ± 50°C.	A new muffle furnace has been purchased and is in operation in the laboratory. Volatile solids are now being run.
3.	Install flow meters on RAS and WAS lines to have reliable flow data for process control of activated sludge system.	RAS system - 8" mag meter. WAS system - 4" mag meter.	Installation of new RAS and WAS meters has been recommended by the A/E firm doing the upgrade design. The design work is 65% complete.
4.	Establish a new effluent sampling location for total and volatile suspended solids prior to the chlorine contact chamber.	Possibly tap into the secondary clarifier effluent line just ahead of the chlorine contact chamber.	A line has been tapped into the secondary clarifier effluent line upstream of the chlorine contact chamber. This has been established as the new effluent sampling location as of April 21, 1994.

TABLE 3.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
5. Level the secondary clarifier weirs to reduce short circuiting and solids carryover.	Will require support from civil engineering squadron personnel. Will require new hardware.	The secondary clarifier weirs are still in need of immediate work. They need to be leveled. However, the inspection of the weirs during the plant down time revealed severe corrosion of the plates and bolts that secure the weirs to the walls of the clarifiers. These problems need to be resolved as soon as possible because of the adverse impact on plant performance being created by the unlevel weirs. Base and plant personnel have initiated an in-house project to level the weirs and replace all existing weir bolts.
6. Obtain additional analytical data on the wastewater treatment plant influent, effluent and sludge.	• Metals and toxic organics semiannually on the influent, effluent and sludge. • COD, TKN and total phosphorous on the influent monthly for six consecutive months.	The base is awaiting a price proposal from an outside contract laboratory to perform the analyses.
7. Upgrade the influent pump station/controls to provide variable speed drives and flow pacing off the influent flow meter.	Forward flow to the plant should not be intermittent as is presently the case.	The upgrade of the influent pump station is being considered as part of plant upgrade currently under design.
8. A plant-wide daily operations log or daily plant checklists should be implemented to ensure that all operator duties are completed each day and a record is maintained of plant operations.	A daily log or operator checksheets will be developed for the O&M manual.	An excellent plant-wide daily operations log has been developed and is in use at the plant.

TABLE 3.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
9. A formal training requirement should be implemented for all employees in the Wastewater Treatment Plant Operator classification.	"Operation of Wastewater Treatment Plants" offered by California State University could be utilized as a course for operators at Howard AFB.	The NCOIC for the WWTP is planning to utilize supplementary training requirements in the civilian and military position descriptions to ensure all future plant employees get wastewater training. The California State University course "Operation of Wastewater Treatment Plants" is on order through the base training office. The base training office will be utilized for the purpose of supervising this correspondence-type course and proctoring chapter examinations.
10. The WWTP should be staffed 24 hours per day. The third shift (2400 Hours - 0800) should be manned as soon as arrangements can be made to provide additional operators or to provide a security fence.	Process observations and adjustments should be made around the clock by plant personnel at activated sludge plants.	The plant is now staffed 24 hours per day.
11. Improve the overall organization of plant filing system.	Make all information readily available and accessible.	Improvement of the plant filing system is in progress.
12. Purchase reference/self-study material listed in Section 3 of this report for the WWTP.		Plant reference material is in the process of being purchased and upgraded through the base library.
13. Provide additional technical training opportunities for the current and future NCOIC of the WWTP.	Technical knowledge is necessary for effective WWTP management.	Mr. Alzamora has recently attended an advanced WW course at Sheppard AFB. The new NCOIC replacing TSgt. Mourning should, at a minimum take the Sacramento course if that individual is not trained in WW treatment.
14. Improve ventilation in Lift Station 735 through installation of exhaust fan and/or louvered windows.	Hydrogen sulfide gas build up evident during evaluation.	This recommendation was erroneous. Lift Station 735 is an outside submersible pump.
15. Implement contract to repair/renovate aeration header line as soon as possible.	TSgt. Mourning indicated on December 20, 1993 that this work was scheduled for early January.	The installation of the new air header line was completed in early April 1994.

TABLE 3.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
16. Maintain a dissolved oxygen (DO) residual of 2.5 mg/l throughout aeration basins.	To ensure adequate D.O. for microbial activity.	The D.O. in the aeration basins is being monitored 3 times on each shift and D.O. profiles of the aeration basins is being be performed on a monthly basis. Close monitoring of basin D.O. and communication about D.O. between the shifts is now occurring. Operators are making adjustments in air flow in accordance with D.O. readings.
17. Control of the aerobic digesters should be established based on percent reduction of volatile solids. Reduction in volatile solids should be greater than 40 % prior to drawing sludge to beds.	Current process control strategy is to reduce volatile matter to 50% in the digester.	Control of the anaerobic digestion process still needs to be implemented. Percent reduction in volatile matter should be calculated weekly on the digesters and used as a basis for deciding when the sludge is stable enough for disposal to the drying beds. Generally, the target is 40% reduction in volatile matter.
18. Sludge should be drawn to the drying beds no greater than 8-12 inches in depth. If reducing depth does not improve dewatering, an evaluation of the drying bed media should be performed to determine if sand and gravel replacement is needed.	8-12 inches promotes rapid dewatering of sludge and facilitates removal of sludge from the beds.	Sludge drawn is now limited to 8-12 inches in each bed. This has greatly facilitated drying of the sludge. The time required has been reduced to 7-10 days.
19. Repair influent flow recorder/totalizer.	Troubleshooting and diagnosis required by manufacturer's representative to obtain estimate of repair/replacement cost.	No action is being taken currently to replace the influent flow recorder. Inspection of the unit by base personnel indicate that it cannot be repaired. This is part of a system which will be upgraded when that part of the plant is renovated. However, a flow chart recorder is an important tool in the daily operation and record keeping of the plant. It should be considered for replacement at the present time.

TABLE 3.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
20. The WWTP should develop a written spare parts inventory.	To ensure that spare parts are available when needed and ordered when depleted.	A written spare parts inventory has been developed. Use of the computer spreadsheet to track and log spare parts use and procurement is planned.
21. The base should help expedite the procurement of maintenance supplies such as grease.	To ensure that there is an adequate supply on hand at all times.	The procurement process for maintenance supplies such as grease has been improved since the Phase I evaluation.
22. Chlorinated samples used for BOD analysis must be dechlorinated and reseeded prior to setting up sample dilutions.	This is a requirement of the test procedure as specified in standard methods.	A composite sample of the pre-chlorinated effluent is now being used for running BOD_5. The WWTP has installed a new chlorination port in the effluent line and new upstream sampling port. Dechlorination and reseeding procedures no longer need to be implemented.
23. Amend lab monitoring procedures per discussions in Section 6.2.2 - 6.2.5.	• BOD • TSS • pH • Fecal Coliform • Temperature Logs • Calibration Records • Bench Sheets	See Table 2.
24. Amend lab record keeping in accordance with Section 6.2.2 - 6.2.5 of the Phase I Report..		Amendment of the lab record keeping procedure is in progress.
25. Run D.O. profiles in the aeration basins monthly.	Refer to Section 6.2.5.	The plant needs a 50 foot cord with D.O. probe to initiate D.O. profiles of the aeration basins.
26. Initiate volatile solids analyses on the aeration basins and aerobic digesters each time total or total suspended solids are analyzed.	Aeration Basins - TSS Digesters - % Total Solids	Volatile solids analysis are now being run on the aeration basins and digesters.

TABLE 3.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
27. Implement improved record keeping and file organization for WWTP records.	• Manufacturer's Literature • Lab Bench Data Sheets • WWTP Log and Supplemental • Daily Log or Checklists	Improvement in the plant record keeping system is in progress.
28. Change the storage location of the SCBA to a point that would be accessible during a chlorine leak.	Possibly the inside wall of the influent pump station building.	This item was completed prior to the second Phase II visit.
29. Install an additional safety shower/eyewash in the same location as the SCBA.	Possibly the inside wall of the influent pump station building.	This item was completed prior to the second Phase II visit.
30. Document weekly safety briefings.	Include topic(s) discussed and person attending.	Weekly staff/safety meetings are being documented in a log book at the WWTP.
31. Provide life rings in the area of the grit chamber and influent wet well.	The nearest life ring to this area is currently on the aeration basins.	New life rings have been ordered for the entire plant.
32. The lead-lag status of the lift station pumps should be manually alternated	Monthly	This recommendation was erroneous. The lift station pumps alternate automatically.
33. Grit and screenings should be buried or disposed of in a sanitary landfill if available.	Surface disposal is a potential health hazard.	Grit and screening are now being taken to a sanitary landfill.
34. Provide a combustible gas/O_2 meter for plant personnel.	Safe entry in lift stations, chlorine rooms, etc.	A combustible gas/O_2 meter for the plant is on order.
Phase II Supplemental Recommendations		
1. Two automatic samplers should be purchased for the plant.	To enhance sample collection and improve data reliability.	Equipment has been ordered.
2. A bulletin should be issued to base housing units regarding rag disposal into sanitary sewers.	Excessive rags in influent/rag accumulation in plant.	TSgt. Mourning made this request through Civil Engineering.

TABLE 3.1 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
SPECIFIC RECOMMENDATIONS AND
STATUS AS OF 6/30/94

	Recommendation	Comments/Significance	Current Status of Phase I Recommendations
3.	Correspondence courses for each operator in Operation of Wastewater Treatment Plants should be ordered from California State University	A two-volume course, approximate cost $100 per operator for books and testing.	Courses are on order.
4.	Operators should obtain certification from the American Boards of Certification (ABC) if possible.	It was agreed that Mike Hewitt of ES would investigate this possibility after the initial Phase II visit.	It was determined that ABC does not issue certification but provides standards for certification reciprocity.
5.	Submerged plant equipment should be inspected and photos taken to document conditions.	During plant down-time.	This item was completed and a report prepared by CE staff. A copy is being forwarded to Gary Nault at HQ ACC.
6.	Install new chlorination point upstream of chlorine contact chamber.	To improve mixing and increase contact time.	This item was completed during plant down time in early April.

TABLE 3.2
HOWARD AFB WASTEWATER TREATMENT PLANT
LABORATORY EVALUATION RECOMMENDATIONS
STATUS AS OF 6/30/94

	Recommendation	Comments/Significance	Current Status
1.	The chlorinated sample used for effluent BOD analysis must be dechlorinated and reseeded prior to setting up sample dilutions. This is a requirement of the test procedure in Standard Methods for The Examination of Water and Wastewater (Standard Methods).	Without dechlorinating and reseeding, the final BOD determination is not considered a viable analysis.	Effluent samples are now being collected prior to chlorination.
2.	The dilution water and samples should be equilibrated to near 20°C prior to setting up the dilutions.	The dilution water should be stored in the bottom of the BOD incubator and the samples left out at room temperature for 1-2 hours prior to initiating the test.	This recommendation has been implemented.
3.	A standard analysis should be run at least 10 percent of time to ensure the accuracy of the analysis for BOD.	The two most common standards analyzed for BOD are glucose-glutamic acid and potassium acid phthalate.	Standards are still on order.
4.	A new procedure needs to be established for calibration of the Dissolved Oxygen (D.O.) Meters.	The procedure was discussed with plant personnel during the second Phase II site visit and a written procedure will be included in the Final O&M Manual.	A new procedure is included in the O&M manual.
5.	A record of all D.O. meter calibrations should be maintained in the lab.	The meter calibration record should include the date, check-offs for redline and zero, calibration method used, temperature, D.O. set point and the initials of the analyst.	A record is being kept but more details are needed as described. An example recordkeeping form is included in the O&M manual.
6.	The calibration of the D.O. meter should be checked after sample readings are made.	To ensure that calibration is maintained within 0.1 mg/L.	This procedural change has been initiated.
7.	In reviewing previous bench data for the BOD test, it was observed that dilution water blanks had 5-day oxygen depletions greater than the maximum allowable 0.2 mg/L.	The source of this problem needs to be investigated and eliminated to ensure that D.O. depletions in all bottles are attributable to the sample dilution and not a problem with the dilution water.	Glassware and apparatus used in the BOD test should be cleaned thoroughly on a regular basis with chromic acid cleaning solution.

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TABLE 3.2 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
LABORATORY EVALUATION RECOMMENDATIONS
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
8. Three dilutions are being set up for each BOD sample. The dilutions do not always yield the proper D.O. drop of 2.0 mg/L or the final D.O. criteria of 1.0 mg/L remaining.	Only the dilutions meeting those criteria should be utilized in calculating the BOD value.	In reviewing recent lab bench data for the BOD test, the D.O. yield criteria is now being adhered to.
9. A laboratory thermometer should be kept inside the BOD incubator, immersed inside a beaker of water, to ensure that the temperature of the incubator is being maintained at 20°C ± 1°C.	A daily temperature record should be maintained for the BOD incubator.	A thermometer is now kept inside the incubator but a log is not being kept.
10. The bench sheets used for BOD should provide information on the methodology from the latest edition of Standard Methods.	18th Edition currently in use.	Example bench sheets were provided in the O&M Manual and a supply has been ordered from the base print shop.
11. The required temperature of the drying oven for the suspended solids test is 103°-105°C.	A thermometer should be inserted into a beaker of sand inside the oven so that stable readings of the interior of the unit are monitored.	Additional thermometers have been ordered for the laboratory.
12. A temperature record should be maintained on the drying oven.	The date, temperature reading, and the initials of the analyst should be recorded daily.	Temperature records are not being maintained as yet. A temperature record log is included in the final O&M manual for use at the WWTP.
13. A distilled water blank should be run 10 percent of the time to ensure the precision of the TSS analysis.	To ensure that the test procedure does not contribute negatively or positively to the final test result.	Blanks are now being run but records for blank TSS analysis are not being kept.
14. The analytical balance should be serviced once per year by a manufacturer's representative or by qualified technical personnel.	Balance calibration is normally performed by PMEL.	No recent calibrations have been performed by PMEL or outside manufacturer's representatives. The next scheduled balance calibration is later this year.

TABLE 3.2 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
LABORATORY EVALUATION RECOMMENDATIONS
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
15. The current procedure utilized in running suspended solids on the aeration basin contents includes straining out of large solids prior to filtering the sample. This practice should be eliminated.	The mixed liquor analysis should include all constituents of the aeration basins to the greatest extent possible.	Problems with large solids particles should be dealt with by using a larger sieve to remove them.
16. The lab should be equipped with an inexpensive lab timer to ensure that the various solids testing procedures are performed in accordance with required time periods.	Solids drying time, sterilization period, and muffle furnace burn time are examples.	No lab timer has been ordered as yet.
17. During the evaluation, it was noted that the current muffle furnace was very old and was reported to be functioning improperly. The temperature controls of the unit were not working. Due to the age and condition of the unit, it is recommended that a new muffle furnace be procured for the laboratory.	This is a critical piece of lab equipment in terms of plant process testing and control. For the plant to utilize sludge retention time (SRT) as the primary process control parameter, the muffle furnace is imperative.	A new muffle furnace was purchased and is in use in the lab.
18. The bench sheet for suspended solids needs amending to include spaces to record all raw data for the test including the weight of crucibles or filter, weight of the crucible or filter plus residue, the weight difference and the final result.	The bench sheet should also include reference to the latest edition of Standard Methods (i.e., 18th Edition), a space to record the date and time of the analysis and a signature block for the analyst.	An example bench sheet was included in the O&M manual.
19. The required water bath incubator temperature for the fecal coliform bacteria test is 44.5 ± 0.2°C. A record must be kept of the water bath temperature on each day that the unit is in service as part of the raw data kept for the test.	A thermometer should be inserted into the water bath incubator for this purpose.	Record keeping for instrument temperature has not been initiated. Additional laboratory thermometers have been ordered.

TABLE 3.2 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
LABORATORY EVALUATION RECOMMENDATIONS
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
20. A record must be kept of the time and temperature for each sterilization cycle.	A fifteen minute sterilization period after the pressure cooker reaches 121°C is required.	Record keeping for instrument temperature has not been initiated. Record keeping logs are included in the final O&M manual.
21. A temperature daily record must be maintained of the refrigerator where samples and media are stored.	Refrigerator temperature should be maintained at 4°C.	Record keeping for instrument temperature has not been initiated. Record keeping logs are included in the final O&M manual.
22. The sample bottles used to collect samples for fecal coliform bacteria are an incorrect type. Standard bacteriological dilution bottles should be obtained for this purpose.	Wide mouthed, screw cap, standard bacteriological dilution bottles are used to collect fecal coliform samples.	These bottles have been ordered through the base health clinic.
23. Sterile, buffered dilution water must be prepared and used during the analysis in strict accordance with the test requirements. The dilution water is a critical component of this test.	It is normally used to set up a sterile blank and to rinse the funnel and filter after filtration of samples.	Sterile buffered dilution water is not prepared. A blank is run with distilled water. Chemicals have been ordered for preparing the dilution water.
24. At least three dilutions should be set up for each fecal coliform sample tested.	Only one dilution prepared currently.	The status of this recommendation is unchanged.
25. Membrane filters should be handled with sterile forceps. In order to ensure sterility of the forceps, they should be sterilized in the pressure cooker along with the other test equipment.	In addition, a small alcohol burner should be obtained and used during the test to resterilize the forceps between handling of membrane filters.	A small pair of forceps should be ordered. An alcohol burner has been received.
26. Denatured alcohol used for the alcohol burner should also be used to wipe down the counter work area prior to initiating the fecal coliform bacteria test.	Helps to ensure sterility of the test environment.	No denatured alcohol is currently available at the plant. This supply item has been ordered.

TABLE 3.2 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
LABORATORY EVALUATION RECOMMENDATIONS
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
27. Data sheets kept for the fecal coliform test should include the following information. • Date and time samples put in water bath • Date and time samples removed from water bath • Analyst's initials or name • Procedure used • Colony counts for all dilutions • Sample volume for each dilution • Fecal coliform per 100 ml for each dilution		An example bench data sheet for the fecal coliform test is provided in the O&M manual.
28. A major concern with regard to the pH analysis is that pH must be run on samples immediately after collection. pH analysis requirements mandate that holding time be kept near zero.	This does not permit pH analysis on composite samples unless that analysis is for internal purposes.	pH is now being run on grab samples taken each morning.
29. When running pH samples, a record must be kept of the sample temperature, sample pH, the date and analyst.	Standard bench data for pH analyses.	Records of pH bench data are not yet being recorded.
30. A record should be maintained of pH meter calibrations including the pH value of the buffers used, the temperature of the buffers, the date and analyst.		pH meter calibration records are not kept presently. A record keeping form for pH is included in the final O&M manual.

TABLE 3.2 - Continued
HOWARD AFB WASTEWATER TREATMENT PLANT
LABORATORY EVALUATION RECOMMENDATIONS
STATUS AS OF 6/30/94

Recommendation	Comments/Significance	Current Status of Phase I Recommendations
31. Field D.O. readings in the aeration basins should, on a regular basis, (i.e., monthly) be taken at several different locations and depths throughout the basin to obtain profiles of the basin D.O.	This will require procurement of a longer cable/probe and the fabrication of a hand held boom to safely lower the probe into the basin at different locations. The boom can be a PVC, heavy gauge pipe with eyelets fastened along its length. The cable will need to be graduated in one-foot increments.	A D.O. meter with a twenty foot cable has been borrowed from Bioenvironmental Engineering. D.O. is being measured in each basin 3 times per shift. A new meter with fifty foot cable/probe is currently on order.

SECTION 4
VERIFICATION PHASE

4.1 VERIFICATION PHASE

4.1.1 Introduction

The Phase III site visit was conducted by Mike Hewitt, ES Project Manager, from August 16-18, 1994. The purpose of the visit was to assess improvements in operation of the WWTP since the initiation of the WWTP Environmental Study Program. The reassessment involved a follow-up evaluation of the individual unit processes, the overall operation of the treatment plant and other areas such as laboratory, preventive maintenance and safety.

As discussed in Section 1 of this report, meetings were held with operators and other key base personnel throughout the Phase III visit. These meetings covered a variety of topics including the status of all improvements made relative to the recommendations made during Phase I.

During the Phase III visit, all applicable operating data was collected for the previous twelve months for evaluation. Operating logs were examined and visual observations of plant processes and activities were conducted.

4.2 OBSERVATION AND CURRENT STATUS

4.2.1 General

Considerable progress has been made in implementing the recommendations made during Phase I of the program. Howard AFB WWTP personnel have been very responsive to guidance and direction provided throughout this project. The area where the plant has made the most progress is in the initiation and implementation of a process control strategy for controlling the activated sludge process. Implementation of effective daily logs and weekly data collection formats, the use of an electronic spreadsheet for storage, calculation and manipulation of process data; and the use of sludge retention time (SRT) as the primary control parameter has greatly enhanced the operation and performance of the WWTP. The process still needs some fine tuning but it has improved dramatically since October 1993.

The plant is still in need of renovation and upgrade in key areas. The plant headworks area needs renovation or complete rebuilding. The influent flow meter, grit chamber and pump station are all contributing to less than optional operating conditions within the WWTP. The plants secondary clarifiers are in poor condition structurally and

have reached their design life of twenty years at present. The plant is in need of flow monitoring equipment for the return and waste sludge lines for proper control of the activated sludge process.

These items are included in the upgrade design which is presently at sixty-five percent completion. Funding for construction of the design upgrade has still not been approved as yet.

A training program is needed to ensure that plant personnel knowledge and expertise is adequate to provide long-term consistent operation of the plant. The recommendation to institute a training standard for operators and to provide a small library of reference and training material have not been resolved as yet. We still believe that the California correspondence course in wastewater treatment would serve the purpose of providing such a training standard. Also it is important that senior operating personnel receive more specialized training from outside training resources.

There are still a number of outstanding items unresolved from the audit of laboratory procedures. These include procedural, recordkeeping and quality control issues.

Several equipment items recommended to enhance the safety program at the plant have not yet been procured. These include new life rings for various locations within the plant and a combustible gas/oxygen meter for safe entry into lift stations and other confined spaces.

There is still a need to improve the overall plant filing and recordkeeping system. Plant records, including operating data, manufacturer literature and maintenance records are kept, but not always readily accessible.

4.2.2 Plant Staffing and Management

Since the initiation of the project there has been a turnover in the NCOIC for the plant. TSgt. Mourning, who left in early July 1994 for a new assignment is not scheduled to be replaced until October or November 1994. TSgt. Mourning provided excellent leadership at the WWTP. His style of leadership stressed the importance of key personnel using their expertise in wastewater treatment. His leadership and delegation to his most senior operator, Mr. Alzamora greatly facilitated many of the improvements made during the past several months. Mr. Alzamora is currently running the plant in an acting superintendent role. Mr. Alzamora has considerable knowledge and expertise in activated sludge operations and under his direction the plant is continuing to improve. He should continue in this role to the greatest extent possible once the new NCOIC is in place, in order to enhance continuity of operation of the WWTP.

Another important change that has occurred since Phase I is the initiation of the third shift. The plant is now staffed 24 hours per day which has also had a positive effect on operations. Continuous monitoring and process adjustments around the clock have decreased the incidences of process upsets. However, isolation of some of the operating personnel on swing and midnight shifts has emphasized the need for operator training.

4.2.3 Plant Operation/Process Control

Several changes have been attempted or made in plant operation and process control. At the plant headworks, plant personnel attempted to get the grit removal system functioning again. The grit screw auger and the trough that it rotates in were removed and renovated. The screw augur drive was modified to reduce the speed. These changes made a small difference but for the most part the system remains ineffective in removing sufficient quantities of grit from the grit chamber. This further points out the need for upgrading the processes at the headworks.

The activated sludge system operation has undergone a number of changes in the past five months. Process control testing has increased greatly and the data has been used in establishing a process strategy using SRT to control the process. Process data collected is loaded into electronic spreadsheet where key process control variables such as F/M and SRT are calculated daily. Sludge is wasted daily to maintain a consistant SRT. Dissolved oxygen measurements are taken in the aeration basins and clarifiers on each shift. Sludge blanket measurements are also taken multiple times on each shift and RAS flow rates are adjusted accordingly. Current process conditions include a MLSS concentration in the aeration basin of 1,000-1,200 mg/l, SRT of five days, F/M ratio of 0.3 - 0.5 or greater, aeration D.O. of 2.5 mg/l and greater. The aerobic digesters are now controlled based upon percent reduction in volatile matter. The base purchased a new muffle furnace early in the project to have volatile solids testing capability.

One of the process problems that the WWTP is experiencing is filamentous bulking. During Phase II of the project, in an attempt to get control of this problem, a procedure was instituted for chlorinating the return sludge stream at a dosage of 1-2 pounds of chlorine per 1,000 pounds of mixed liquor suspended solids.

The procedure brought rapid results in reducing the amount of filamentous organism in the sludge, reducing the sludge volume index, improving settleability and preventing the loss of the solids blanket from the secondary clarifier. Control of the filamentous problem allows the plant staff to operate the plant much more effectively. However, the filamentous bacteria problem has reoccurred and necessitated repeating the chlorination procedure. Although this procedure is commonly used to control filamentous bacteria in plants throughout the US, there is a desire on the part of the base personnel to use biological means of controlling the filamentous growth if possible. Common biological means of reducing filamentous organisms include high D.O., low D.O., in plants where complete nitrification is occurring, higher SRTs and lower F/Ms. The Howard WWTP staff are beginning the process of increasing SRT and lowering the F/M in an attempt to solve this problem. These actions should also improve treatment efficiency and help optimize the treatment process.

4.2.4 Plant Performance

Twelve months of data were compiled during the Phase III visit. The data indicates that there were no instances of noncompliance with average Overseas Baseline Guidance

Document Criteria during the period. However, there were three months when the effluent discharge exceeded the maximum criteria for BOD and four months during which the maximum criteria for total suspended solids were exceeded. Those criteria are 65 mg/l for BOD and TSS. These incidents were the result of filamentous bulking prior to the institution of the RAS chlorination procedure. Figures 4.1, 4.2, 4.3 and 4.4 illustrate the monthly averages for the Flow, BOD, TSS and Fecal Coliform Bacteria versus the respective average discharge limits over the period August 1993 through July 1994. Figure 4.5 and 4.6 illustrate the maximum BOD and TSS levels versus the discharge limits for the same period. Although there are no Overseas Baseline Criteria for Fecal Coliform Bacteria, for purposes of comparison, standard secondary average NPDES limits were used in the Figure 4.6.

4.2.5 Plant Maintenance

The plant maintenance program is essentially the same as it was in October 1993. The plant utilizes the base-wide Recurring Work Program (RWP). The RWP system generates weekly list of items requiring maintenance on the Recurring Work Program Report (RWPP). Once completed, these items are entered into the system for permanent recordkeeping. Items not completed appear on subsequent RWPPs as outstanding. Each item scheduled is generated from a master file which is cross referenced to Maintenance Action Sheets (MAS). The MAS provide details of maintenance tasks to be performed from the RWPP. The plant developed a written spare parts inventory during the project. This is an informal list of items kept in the compound at the plant. It is further recommended that the spare parts listing be kept up using the plant computer. Parts used can be readily logged into a spreadsheet and subtracted from those in inventory. Parts received from ordering can likewise be logged in and added to the inventory.

4.2.6 Laboratory and Sampling Program

An audit of the laboratory and sampling program was conducted during the Phase I Evaluation at the WWTP. A total of thirty-one items were identified for correction or addition to the program. Approximately two-thirds of these recommendations were still outstanding during the Phase III visit. Most of these items are small procedural or recordkeeping details that are normally required by regulatory agencies in the U.S. The procedures for the BOD, TSS and pH being used are in accordance with standard procedures. The procedures currently being used to perform the Fecal Coliform Bacteria test needs considerable modification to adhere to the requirements of Standard Methods for the Examination of Water and Wastewater. Many of the items needed to run these analyses correctly have been ordered.

As recommended, a new sampling location was established for collecting samples for BOD and TSS. TSS data is needed prior to chlorination for process control and BOD samples should either be collected prior to chlorination or dechlorinated and reseeded. To resolve these issues, a sample point was established in the clarifier effluent line upstream of the chlorine contact chamber. New D.O. monitoring points were established both in the aeration basins and the clarifiers. A sludge judge was procured for measuring

FIGURE 4.1

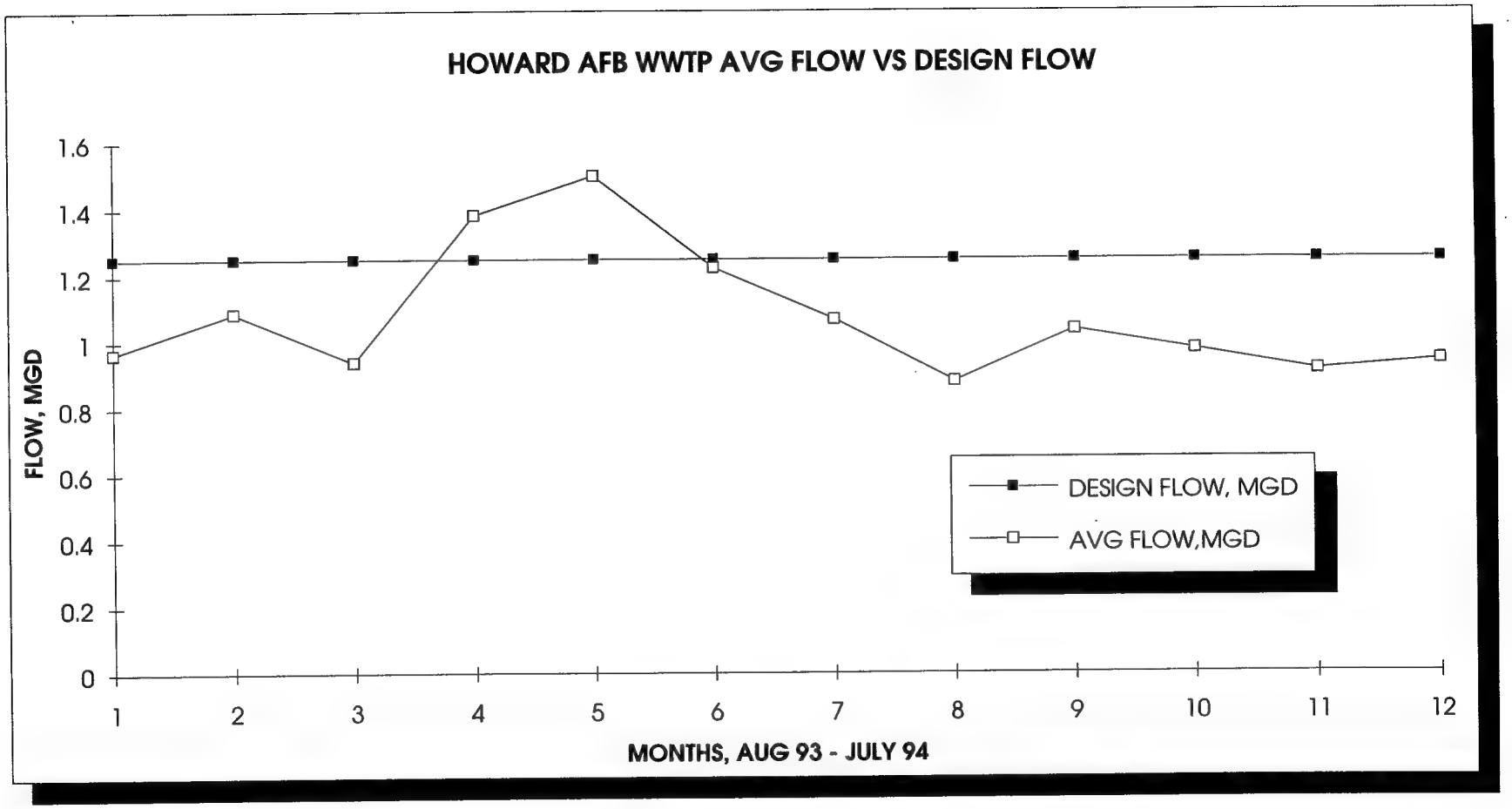

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FIGURE 4.2

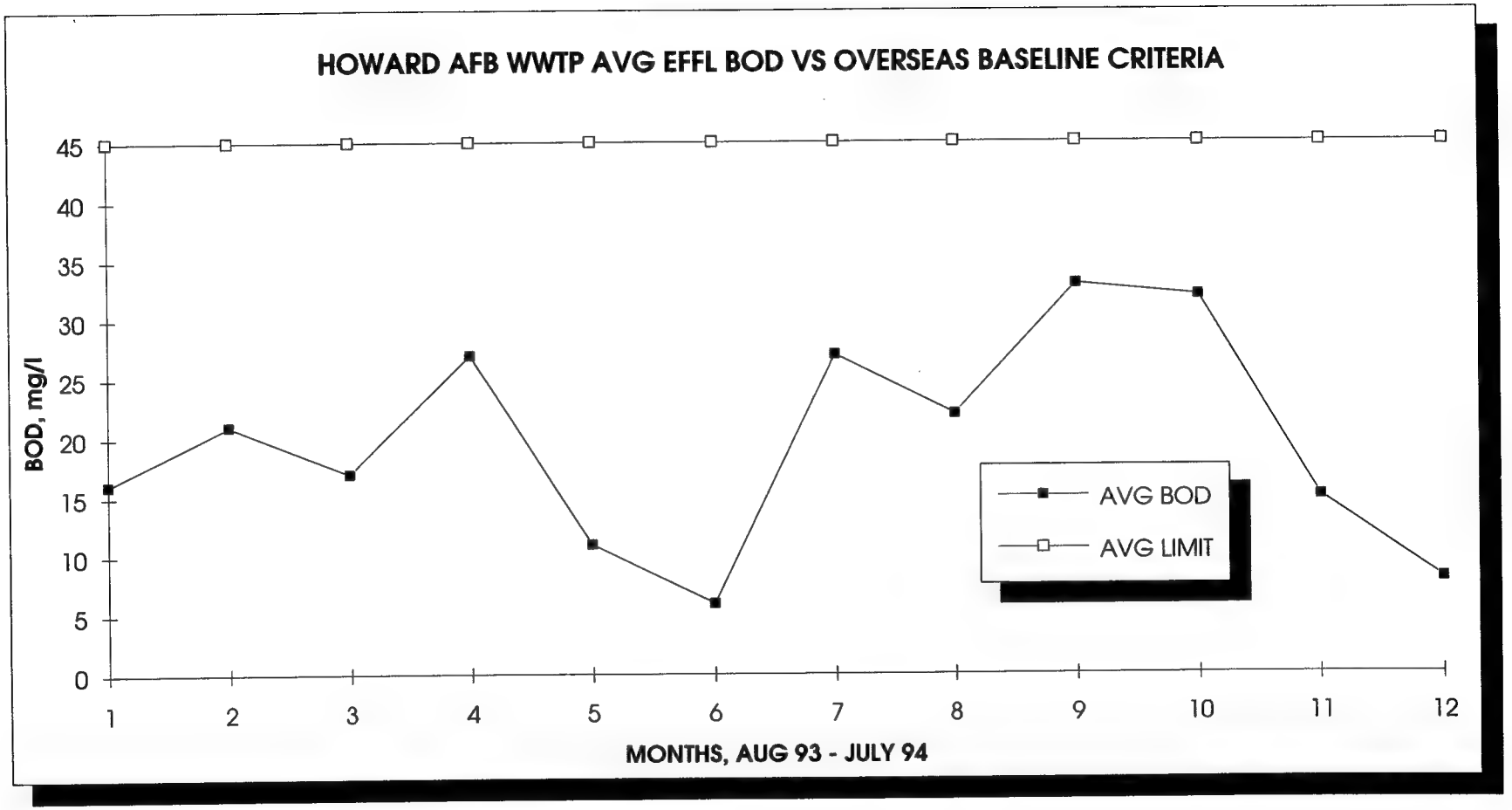

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FIGURE 4.3

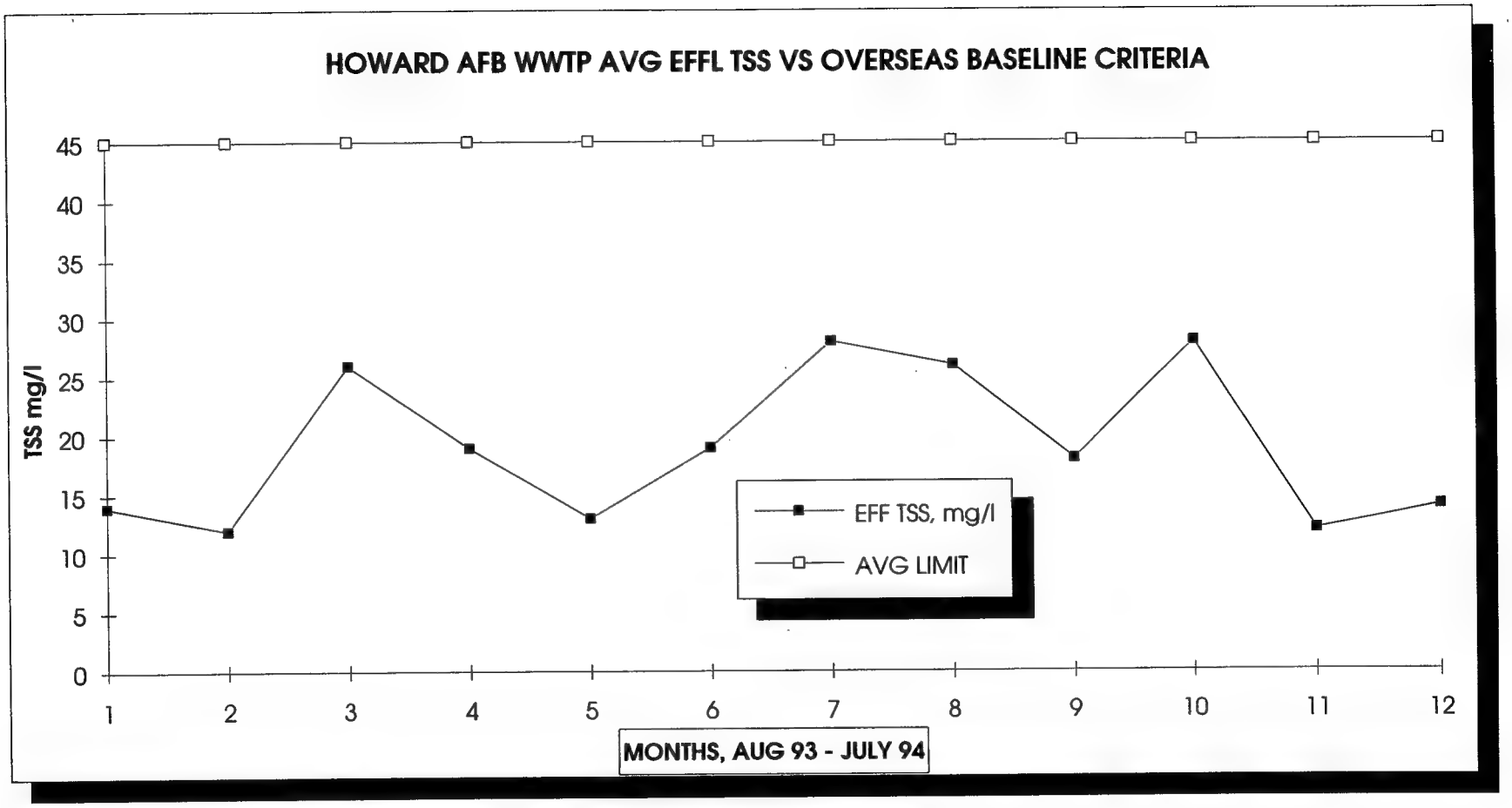

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FIGURE 4.4

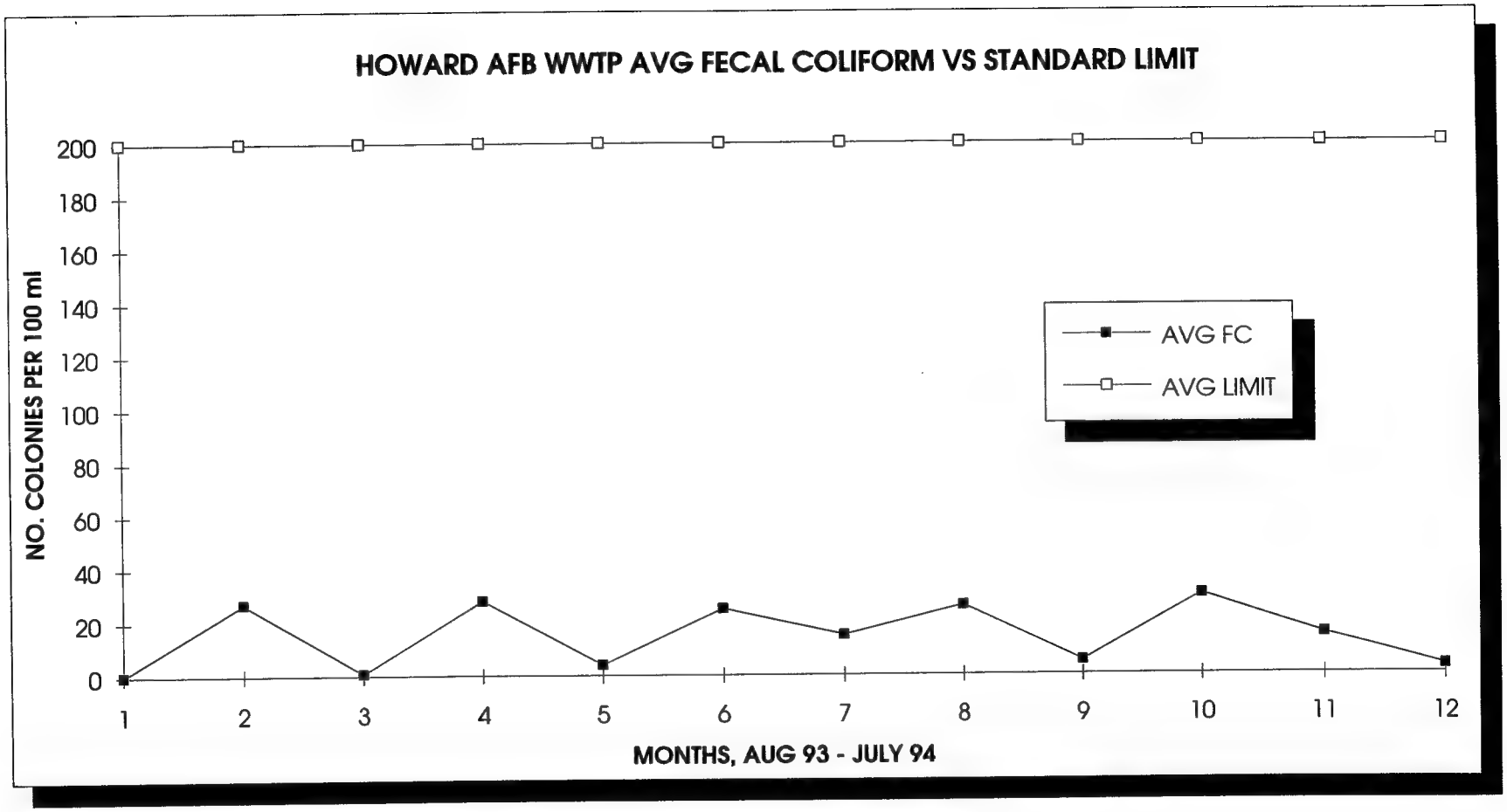

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FIGURE 4.5

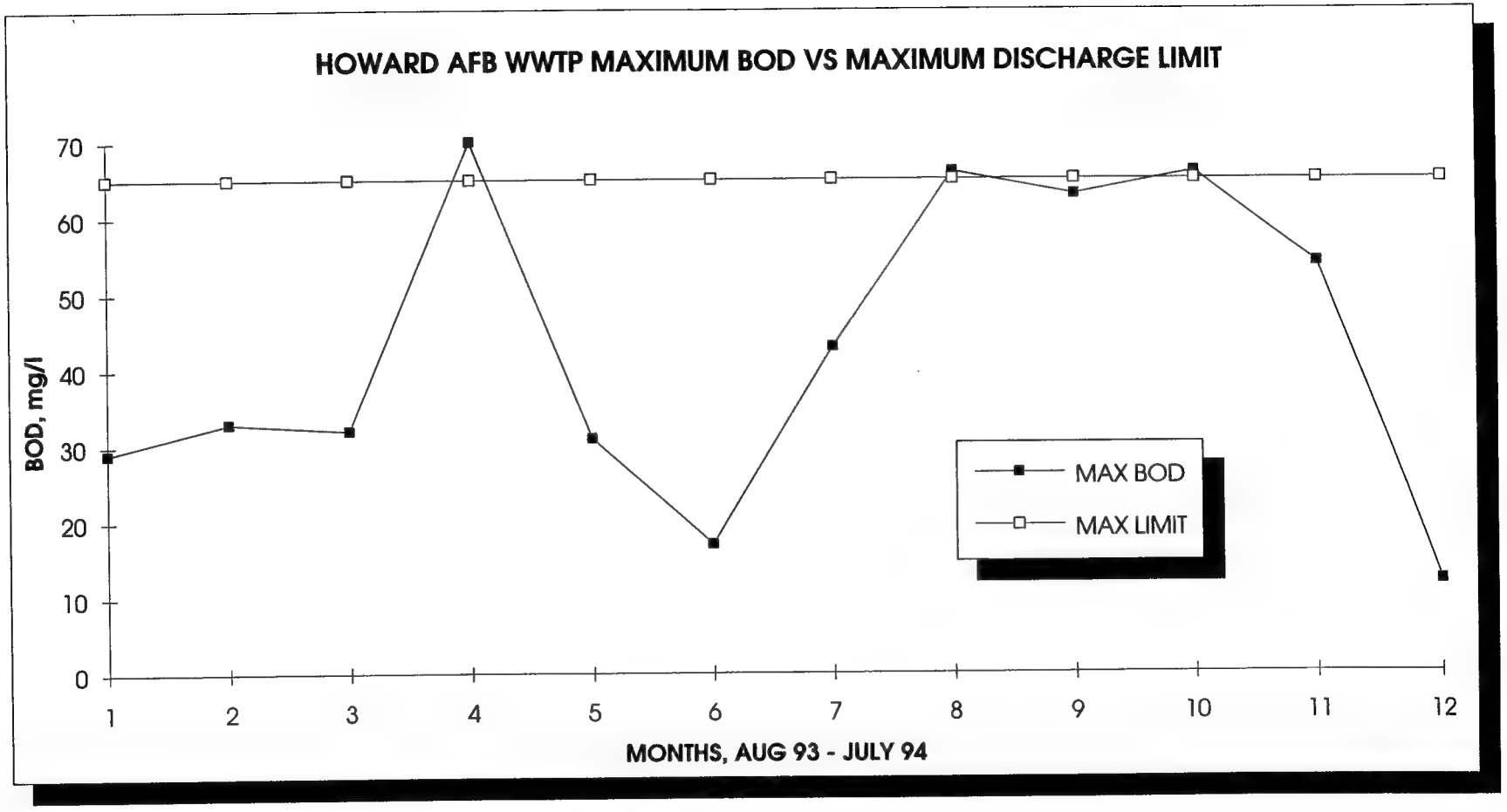

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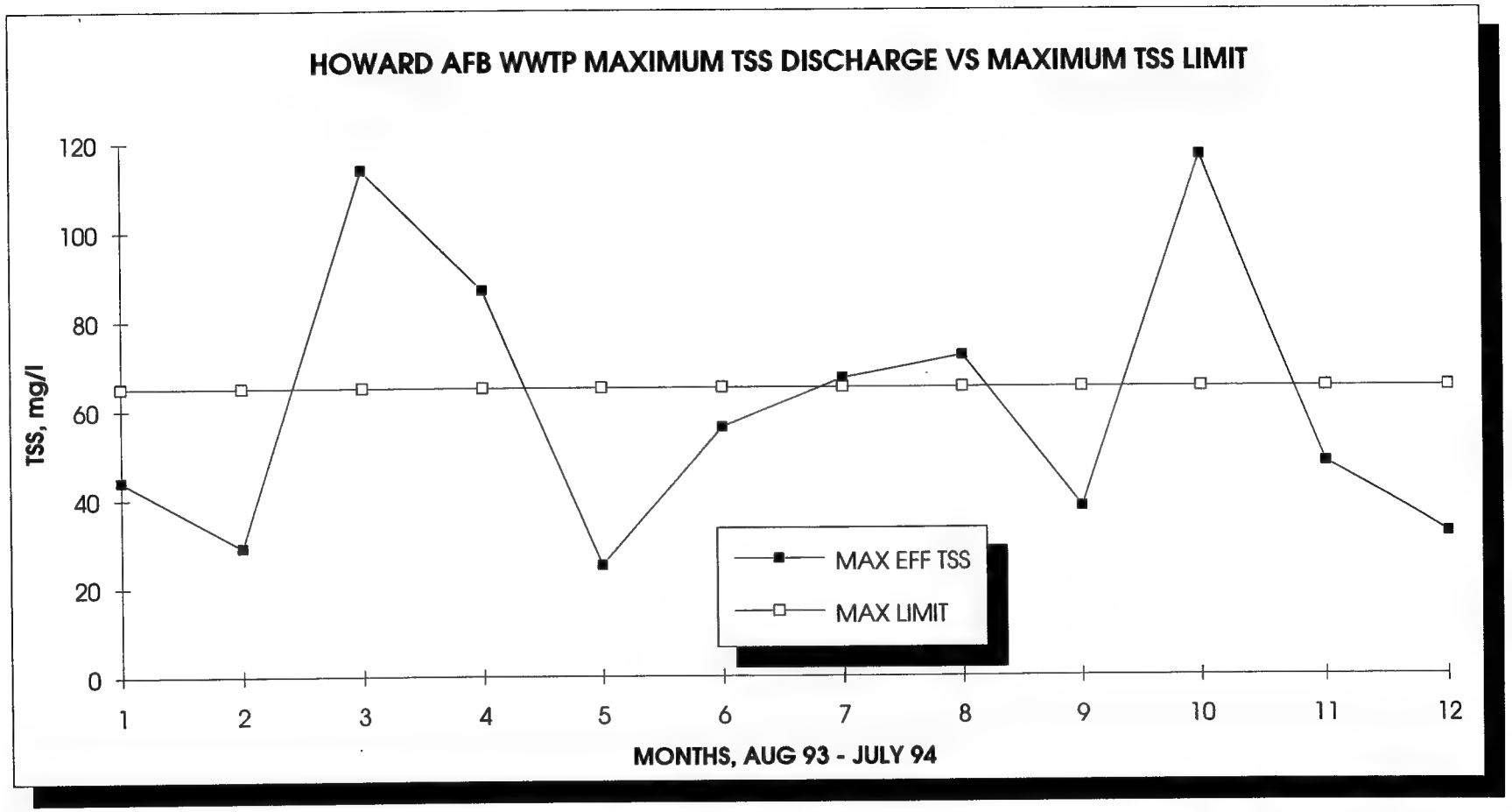
FIGURE 4.6



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sludge blanket depth in the final clarifiers. There are no outstanding sampling issues unresolved except more extensive D.O. profiles should be run periodically within the aeration basin to ensure that adequate dissolved oxygen is present at all depths and locations throughout the basins.

4.2.7 Recordkeeping

As mentioned in Section 4.2.5, there are some outstanding issues related to laboratory recordkeeping which should be addressed. More systematic and complete bench data should be kept as well as records of instrument temperature and calibration.

Considerable more recording of plant operational data is being done now than at the beginning of the project. The plant staff developed a new daily operation log on which is recorded all pertinent operation data for each day. In addition, a weekly lab sheet is kept which summarizes all lab and process data for the week. Much of this data is entered into an electronic spreadsheet. Overall this is a very strong area of plant operation and the plant staff should be commended.

The organization of plant records is still somewhat loose. Daily, monthly and weekly logs are not filed in an organized manner and, are not readily accessible when needed.

4.2.8 Safety

Most of the items recommended during Phase I for improving the plant safety program have been resolved. The storage location of the plant SCBA unit was moved away from the chlorine storage area. A second eyewash/safety shower was provided for the plant and installed in the area of the influent pump station building. This provides emergency eyewash/safety shower on the plant grounds as needed. The original unit is at the control building. The plant holds weekly safety briefings which are documented.

The outstanding items are the need to procure new life rings at all open tank locations in the plant and to provide an oxygen/combustible gas meter to check the atmosphere prior to safe entry into confined spaces.

4.2.9 Industrial Waste Monitoring and Control

The one issue related to industrial waste monitoring that needs to be addressed is the establishment of a regular monitoring program at the plant for metals and toxic organics. During the Phase I Evaluation, a number of industrial sites on base were inspected and waste handling practices were discussed with personnel at these shops. No definitive conclusions were reached from these inspections. Although there appeared to be a potential for industrial wastewater reaching the sanitary sewer and negatively impacting the WWTP, there was no evidence to suggest that it was occurring. We felt strongly then that to adequately assess industrial wastewater impact on the WWTP that the plant influent, effluent and sludge should be sampled and analyzed for heavy metals and total toxic organics. This should be conducted annually.

SECTION 5
PROGRAM SUMMARY

5.1 PROGRAM SUMMARY

5.1.1 Summary of OMTAP Goals and Accomplishments

The objective of the WWTP Environmental Study program at Howard AFB was to assist the installation in improving and optimizing the performance of the WWTP. The prime objective was to help ensure compliance with Overseas Baseline Guidance Document Criteria at the lowest practical cost. This task involved a diagnostic evaluation of the WWTP as a whole and of individual treatment units, review of operator and management structure, laboratory and sampling operations, record keeping, maintenance practices, safety and all related functions. Subsequent activities included follow-up implementation and support for recommendations made, production of an O&M manual to guide future operations, and verification of plant performance changes generated by the program.

In each phase of the program the ES WWTP Environmental Study team made every effort to bring to management's attention the problems which were encountered that were affecting plant performance and to provide definitive, cost-effective recommendations on how to correct them. Management involvement is critical to the success of this type of evaluation and corrective action program.

5.2 BENEFITS OF THE WWTP ENVIRONMENTAL STUDY PROGRAM

There are many benefits associated with the WWTP Environmental Study program at Howard AFB. Many of the recommendations have cost little or nothing to implement at the WWTP. Other recommendations, when fully implemented, will result in cost avoidance or reallocation of resources for more efficient operation. Among the major benefits attributable to the program include:

- The increased process control analyses and additional sample points, have allowed the operators to gain additional knowledge to base process decisions upon.
- The establishment of a process control strategy and the improved control of the activated sludge process have given key members of the plant staff a renewed

confidence in their inability to properly operate the plant. This has improved staff morale at the WWTP.

- The increased involvement of management personnel in plant operation decisions has improved knowledge of plant operational issues and facilitated improved oversight and management of the facility.
- The audit of lab procedures resulted in the resolution of many procedural and record keeping deficiencies which have brought the lab into improved compliance with requirements for the required laboratory analyses.
- Recommendations made for additional or enhanced process or monitoring equipment to improve WWTP operations were incorporated into the current upgrade design such that upon completion of the upgrade, plant operability will be improved. Examples include variable speed drives for the influent pumps and metering of the RAS and WAS systems.

5.3 LESSONS LEARNED

In any project similar in scope to the WWTP Environmental Study, a number of lessons will be learned. These can serve as tools to ensure future projects are even more effective and serve to point out to management areas of particular attention after the program ends. The lessons learned during the Howard AFB project include the following:

- The timely receipt of documents by the evaluation team is an essential element in the project's success. This allows the OMTAP Team to be familiar as possible with the plant and plant problems prior to the initial visit to the facility.
- The need for involvement and communication with all operators is essential to the success of the program. This is especially true with regard to the written reports and the draft O&M Manual prepared by the team. The recommendations and desired results from all changes must be fully understood by all personnel.
- The procurement of additional laboratory equipment that is recommended should be initiated as early as possible in the program. This allows time for the team to assist the operators in getting the new procedures implemented during the subsequent visits.
- The time period when a plant upgrade design is underway is an excellent time to undertake a WWTP Environmental Study. The meshing together of engineering design and operational review and assessment provides an opportunity to enhance the future operability of the WWTP.
- The overall effectiveness of the project and the receptiveness of plant staff to the evaluation team recommendations are greatly impacted by the NCOIC for the

WWTP. At Howard AFB the WWTP Environmental Study was given a great deal of impetus by TSgt. Roland Mourning. His efforts provided momentum throughout the project. His initiatives resulted in the implementation of may project recommendations.